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Naval Health Research Center

Document No. 11-47

This research was conducted in compliance with all applicable federal regulations governing the protection of human subjects in research.

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Pages: 16
Words: 3,083
Tables: 5
Figures: 0
References: 22
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Report 11-47 was supported by the Department of Defense under work unit number 60332.The views expressed in this article are those of the authors and do not necessarily reflect the official policy or position of the Department of the Navy, Department of Defense, or the U.S. Government. Approved for public release; distribution is unlimited. This research has been conducted in compliance with all applicable federal regulations governing the protection of human subjects in research (protocol NHRC.2003.0025).

KEYWORDS
Military Personnel, Iraqi Combat Theater, Leisure Time Injury

ABSTRACT

This study examined leisure-time sports injuries and lost duty time among U.S. Marines deployed in Iraq. All sports and recreational injuries in Iraq during 2004–2006 were identified from a combat trauma database, in which all in-theater medical treatment was recorded. The study population consisted of 555 Marines who sought treatment for a sports injury during this period. The majority of cases were men aged 21–25 years with a high school education and mid-range enlisted rank. Demographic and military descriptors were related to the type of sports activity engaged in when injured, but had little association with injury characteristics. Type of sports activity, however, was associated with anatomical site of injury, injury mechanism, type of injury, and injury severity. Over 60% of sports injuries occurred during weightlifting, aerobics, and basketball. Some loss of duty time occurred in 46.5% of all sports injuries. Multivariate analyses indicated that rank, occupational specialty, sport played when injured, anatomical location of injury, and injury severity were significant independent predictors of lost duty time. These findings describing leisure-time sports injuries among deployed Marines may be informative for preventive interventions to reduce sports-related injuries and lost duty time in combat theaters.

INTRODUCTION

The duties that U.S. Marines are assigned to perform while deployed overseas provide numerous cardiovascular benefits, and also require a Marine be in a physical condition similar to the intercollegiate athlete.[1-3] To stay in shape, Marines incorporate competitive sports, weight lifting, and other vigorous methods of exercise into their daily physical training regimen.[4] Although deployed Marines are at risk of injury because they are subjected to deleterious chemicals and environments, a leading cause of morbidity is sports and recreational injury sustained during leisure time.[5] In 1992, during Operations Desert Shield and Desert Storm, sports and recreational injuries were the leading cause of hospitalization among Army and Air Force active-duty personnel.[6] Many sports injuries are caused by poor training practices, improper equipment, lack of conditioning, or insufficient warm-up.[7] Poorer physical fitness or circumstances that can lead to a decline in physical conditioning may put a person at increased risk for an athletic or recreational sports injury.[8–11]

Due to specific job assignments during deployment, some Marines may have less opportunity to train physically and may lose some conditioning and lean body mass, placing them at higher risk for sports and recreational injuries.[12,13] In addition to the effects that sports injuries can have on military readiness, they also can be very costly in terms of time away from work and potential compromise to group operational readiness.[14] Thus, research to identify patterns of sports injuries during military deployment may improve care and prevention.

This study examined leisure-time sports injuries among U.S. Marines deployed in Iraq. Primary aims were to (1) describe sports and recreational injuries for which Marines deployed in Iraq sought medical treatment; (2) identify demographic, military, activity-related, and injury-

related correlates of these injuries; and (3) identify the factors that were significant predictors of lost duty time due to sports injuries.

METHODS

Study Design and Data Records

This cross-sectional study examined the medical treatment records of 555 deployed Marines who sought medical care for a leisure-time sports injury sustained in Iraq from December 1, 2004, through December 1, 2006. The data source was the Expeditionary Medical Encounter Database (EMED), formerly known as the Navy-Marine Corps Combat Trauma Registry, which is maintained by the Naval Health Research Center, San Diego, California. The EMED is a deployment health database that includes clinical records for U.S. service members who receive medical treatment at far-forward medical treatment facilities in regions where forces are deployed. Clinical data are added to the database to document injury, disease, psychiatric profile, procedures administered, clinical complications of care, and patient outcome. In addition, *International Classification of Diseases*, *9th revision* clinical diagnosis codes and *Diagnostic and Statistical Manual of Mental Disorders, 4th Edition* psychiatric diagnosis codes are assigned. For battle and nonbattle injuries, injury severity is quantified using the Abbreviated Injury Scale and the Injury Severity Score (ISS).[15] These coding schemes allow each injury to be scored for severity, thereby permitting analyses relating severity and treatment to ultimate rehabilitative outcomes.[16]

The study population examined here consisted only of records coded as injured in a sports or recreational activity; work-related injuries were excluded. Each case must have received care in Iraq at a U.S. battalion aid station, shock trauma platoon, or a forward resuscitative surgical facility. If a Marine came into a treatment facility with more than one

injury, only the most severe injury was used for these analyses. Also, if a Marine had multiple medical visits for sports injuries, only the first visit was included.

Description of Measures

Measures examined in this study were divided into three categories: demographic, military related, and injury related. Demographic variables included age and education (dichotomized as high school or less versus some college or higher). Military variables included: (1) military occupational specialty (MOS), subgrouped as combat, intelligence and logistics, and support categories; (2) military rank, subgrouped as Private to Lance Corporal (E1 through E3), Corporal to Staff Sergeant (E4 through E6), Gunnery Sergeant to Sergeant Major (E7 through E9), and officers (including Warrant Officers); (3) number of deployments; and (4) number of months in current deployment. The number of deployments and the amount of time deployed was determined from Defense Manpower Data Center records.

The sports injury variables included (1) sport that the Marine was participating in when injured, (2) injury mechanism, (3) anatomical location of injury, (4) injury type, (5) ISS, and (6) whether the injury resulted in any lost duty time. Lost duty time was scored as a dichotomous variable based on whether the medical provider determined that the patient's disposition after receiving medical treatment was "limited or no duty" (injury coded as resulting in lost duty time) versus "return to full duty" (injury coded as no lost duty time). Chronic injuries were only counted if there was an acute aggravation of a past injury.

Statistical Analysis

Chi-square analysis was used at the bivariate level to relate military factors, demographic variables, and injury variables to the lost-duty dichotomous variable. For all tests, an alpha of .05 was set as the criterion for statistical significance. For tests with significant chi squares, adjusted

standardized residuals of cells were examined to determine which cells had observed counts sizably different from expected counts. An adjusted standardized residual greater than or equal to absolute 1.7 (roughly equivalent to a one-tailed $p < .05$ level of significance for exploratory analysis) was used as the criterion to indicate that a cell had more (positive residual) or less (negative residual) observed events than expected. Multivariate logistic regression was used to identify independent correlates of lost duty time (yes/no) resulting from the sports injury. All variables that were significantly related to lost duty time in the bivariate analyses were entered into the multivariate analysis, and then eliminated one at a time until only significant ($p < .05$) predictors remained in the model. Data were analyzed using SPSS version 17.0 (SPSS Inc., Chicago, IL)

RESULTS

Descriptive Statistics of Study Population

Demographics. Over a 2-year period, 555 Marines deployed in Iraq were injured during sports activity: 531 male, 24 female. These Marines ranged from 18 to 55 years of age and 53.0% were in the 21–25 years age range. Almost 88% of these Marines had a high school education or less (see Table I).

Military factors. MOS subgroup classifications of the study population comprised 51.5% support, 34.4% combat, and 14.1% intelligence and logistics specialties. The rank composition was 33.2% E1–E3, 50.3% E4–E6, 7.3% E7–E9, and 9.2% officers. Almost 77% of the sample had an athletic injury within the first 6 months of deployment, and 69% were on their first deployment.

Sports and injury factors. Also shown in Table I, the most common sports being played when injured were weight lifting, aerobics, and basketball. The most frequent injury mechanism

was lifting, followed by falls/trips and twists/pulls. The most common injury type was sprain/strain (63.1%). The most frequently injured anatomical region was the lower extremities (39.3%) followed by the upper extremities (31.9%). Most of these sports-related injuries were coded with the lowest possible ISS of 1 (87.8), with only 12.2% of injuries having an ISS of 2 or higher. Of all these documented injuries, 46.5% led to some lost or restricted duty time.

[Insert Table I about here.]

Bivariate Associations with Sport Played When Injured

Sport played when injured and demographic factors. Education level was associated with the sport being played at the time of injury ($p = .017$). Those Marines with some college education were more likely to be injured while participating in aerobics and weight lifting (see Table II). By contrast, boxing and wrestling injuries were more likely among Marines with a high school education or less. Age also was related to the sport played at the time of injury ($p = .02$), with weight lifting injuries most common in those aged 33 years or older, but football and boxing/wrestling injuries were more common in those aged 25 years or younger.

Sport played when injured and military factors. Also shown in Table II, the sport played at the time of injury was significantly associated with MOS subgroups ($p = .03$). Those who worked in intelligence and logistics specialties were more likely to have been injured while lifting weights, and those in combat specialties were more likely to have been injured boxing/wrestling.

[Insert Table II about here.]

*Sport played when injured and injury characteristics***.** The comparisons of the sport played by the injury mechanism and anatomical location were both significant ($p < .01$). Marines who were injured during basketball or aerobics had a higher probability of being injured by a

fall/trip, accounting for 43.5% of basketball injuries and 34.5% of aerobics injuries (see Table III). Most injury mechanisms were consistent with the activity (e.g., "lifting" when weight lifting; "struck by another" when wrestling/boxing, playing volleyball, football, or basketball). Of all aerobic injuries, 74.3% were to the lower extremities, as were 64.7% of basketball injuries. Upper extremities injuries were more prevalent when playing football or weight lifting.

Bivariate Associations With Injury Severity

The sport engaged in when injured was significantly associated with ISS ($p = .016$; see Table III). Volleyball, wrestling/boxing, football, and weight lifting all were more likely to be associated with an ISS of 3 or higher. ISSs for sports injuries also were examined in relation to demographic and military factors (although not tabled). Injury severity was significantly ($p = .044$) related only to MOS, with combat specialties more likely and intelligence and logistics specialties less likely than expected to have an ISS of 3 or higher. None of the other demographic or military factors were associated with injury severity ($p > .05$).

[Insert Table III about here.]

Bivariate Predictors of Lost Duty Time From Sports Injuries

Lost duty time and demographics. Education and age both were related to experiencing lost duty time as a result of the sports injury (see Table IV). Lost duty time was more common among Marines with a high school education or less than those with a college education. Also, the percentage of injuries that resulted in lost duty time among those aged 21–25 years (51.7%) was significantly higher than expected, whereas the percentage among those 33 and older (29.3%) was significantly lower relative to the group average of 46.5%.

Lost duty time and military factors. Both rank and MOS were significantly associated with lost duty time from sports injuries ($p < .01$). E1–E3 ranks were more likely and higher

enlisted ranks E7–E9 and officers were less likely to lose duty time as a result of sports injuries (see Table IV). Marines working in intelligence and logistics specialties also were less likely to lose duty time as a result of sports injuries.

Lost duty time and injury-related variables. Lost duty time was significantly ($p \leq .01$) related at the bivariate level to the sport being played at the time of injury, injury mechanism, anatomical location, injury type, and injury severity (see Table IV). Marines injured while playing basketball were most likely to have lost duty time (65.9% of all basketball injuries), whereas those injured while weight lifting were least likely (35.7%). Falling/tripping was the injury mechanism that had the highest probability of resulting in lost duty time, with lifting least likely to result in lost duty time. Injuries to the lower extremities were the most likely anatomical site, and dislocations and fractures were the most likely injury types to result in a loss of duty time. Almost 80% of injuries with an ISS of 3 or higher resulted in lost duty time.

[Insert Table IV about here.]

Multivariate Predictors of Lost Duty Time

All variables having significant bivariate associations with lost duty time were entered into the multivariate analysis to identify the factors independently associated with any lost-duty time due to a sports injury. Those initially included were education, age, rank, MOS category, sport played, injury mechanism, injury type, anatomical location, and ISS. The final set of significant ($p \leq .05$) predictors of lost duty in the multivariate model included rank, MOS, sport, anatomical location, and ISS (see Table V).

The odds that a sports injury would produce lost duty time decreased as rank increased. Marines in the E1–E3 group had a 4.43 times higher odds ($p < .01$) of a sports injury leading to lost duty time compared with those in the officer category. MOS was another significant

predictor, with 2.78 higher odds of lost duty for Marines in a combat MOS ($p < .01$) and 2.28 higher odds for those in support specialties ($p < .01$) compared with Marines in the intelligence and logistics specialties.

Type of sport was associated with lost duty time at the multivariate level ($p < .05$). With aerobics as the reference group, the odds ratio (OR) for basketball was 2.48 ($p < .01$) while the ORs for the other sports ranged from 0.73 to 1.63, none of which were statistically significant ($p > .34$). Anatomical location of the injury was also significantly ($p = .02$) related to lost duty time. The odds of lost duty time were 2.24 times higher for lower extremity injuries ($p = .03$). Lastly, the odds for lost duty time increased with the sports injury's severity ($p < .01$). With an ISS of 1 as the lowest injury severity as the reference category, the odds of lost duty time were slightly higher (although not significantly) for injuries with an ISS of 2 (OR = 1.82, $p = .24$) but were 6.43 times higher for injuries with an ISS > 2 ($p < .01$).

[Insert Table V about here.]

DISCUSSION

This report describes the epidemiology of injuries incurred while participating in sports or recreational activities among U.S. Marines deployed in a combat zone. In general, demographic and military-related factors were associated with the sport or leisure activity being played when injured, but not to the characteristics of the injuries themselves, while the sport engaged in was related to all the injury characteristics, including injury severity. The most common sports to involve injury were weight lifting, aerobics, and basketball; and the most frequent injury mechanism was lifting, followed by falls/trips and twists/pulls. The most common injury type was sprains/strains, and the most frequently injured anatomical regions were either lower or upper extremities. Most of the documented sports-related injuries were coded

with the lowest possible ISS, with only 12.2% of injuries having higher scores. Weight lifting produced the most sprains/strains. The majority of lower extremity injuries were caused by falling/tripping while playing basketball or engaging in various aerobic activities.

The multivariate analyses to predict lost duty time resulting from sports injuries produced a reasonable model. Severe injuries would be expected to involve lost duty time, so it was not surprising that the most severe injuries produced the greatest odds of experiencing restricted or limited duty. The effects of rank and MOS in respect to lost duty time could be explained by assuming that individuals in jobs with greater than average physical demands are more likely to be judged unable to meet those demands.[17] The effects of rank could also be explained by assuming that leadership by example, including continuing to perform when injured, is an important consideration for officers and that affects medical decisions in marginal cases. The effects of anatomical location could reflect knowledge of job demands. Marines commonly encounter requirements for moving from one place to another while carrying loads that include weapons, ammunition, personal protective equipment, and supplies. These activities require lower body strength, stamina, and core strength that would be impaired by injuries to the lower extremities and pelvis/abdomen/thorax regions.

Clinical Implications

Findings from this study and others show that younger Marines account for the majority of recreational injuries,[18] indicating that some intrinsic correlates of sports-related injuries are not modifiable. However, various extrinsic correlates might be modified to reduce the likelihood of sports injuries and lost duty time among deployed military personnel.[19] Preventive measures, such as taping joints and the use of knee and ankle braces, may help lower the number of injuries to the lower extremities.[20–21] Weight-lifting injuries, which comprised about a quarter of the

sports injuries in this study, might be reduced by enforcing a buddy or spotter program. The sizable number of injuries from contact sports also raises the issue of whether protective gear was available, including whether proper footwear was worn.

Environmental factors that affect the likelihood of injury, such as the terrain where military members engage in sports activities, should also be addressed. For example, many of the medical records examined in this study noted that the service members tripped on rocks, stepped in holes, or ran into objects. Further, the most severe injuries tended to occur while participating in football, volleyball, wrestling, and boxing, so efforts to reduce the likelihood of injuries in these activities could be especially useful (e.g., improving field conditions and ensuring that sports activities are refereed). Lastly, research has shown that those in better physical shape before entering the services are less likely to be injured.[22] Therefore, having service men and women in optimum physical condition before deployment may also help prevent recreational injuries in theater.

Limitations and Conclusions

This study has several limitations. First, the decision to focus on just those injuries derived from leisure-time sports or recreational activities made it impossible to determine how much those injuries contributed to the overall frequency of nonbattle injuries in theater. It also was not possible to determine the actual amount of lost duty time. Thus, it was not possible to evaluate the contribution of sports and leisure activities to overall injury morbidity, or to estimate the total time lost as a result of particular injuries. Further, injury rates could not be computed because denominator data were not available.

In summary, the data presented here on leisure-time sports activities indicate that they produce a morbidity burden for deployed troops. On the whole, demographic and military factors

were related to the type of sports activity engaged in when injured, but had little association with injury characteristics; on the other hand, type of sports activity was associated with the anatomical site of the injury, injury mechanism, type of injury, and injury severity. Multivariate analyses also showed that time lost from full-duty status was related to injury severity, rank, MOS, anatomical location, and sport being played when injured. The study has provided a general description of the epidemiology of leisure-time sports injuries in deployed U.S. Marine Corps personnel. These finding should be a useful point of departure for studies to replicate the current observations and associations, identify subgroups more likely to have particular sports-related problems, and suggest preventive interventions to reduce sports injuries and lost duty time in combat theaters.

REFERENCES

1. Carlson SA, Hootman JM, Powell KE, Macera CA, Heath GW, Gilchrist J, Kimsey CD Jr., Kohl HW III: Self-reported injury and physical activity levels: United States 2000 to 2002. Ann Epidemiol 2006; 16(9): 712–9.
2. Cheng YJ, Macera CA, Addy CL, Sy FS, Wieland D, Blair SN: Effects of physical activity on exercise tests and respiratory function. Br J Sports Med 2003; 37(6): 521–8.
3. Kruger J, Yore MM, Ainsworth BE, Macera CA: Physical activity patterns associated with weight-control status: differences by race and sex. J Phys Act Health 2008; 5(3): 456–68.
4. Commandant of the Marine Corps: Marine Corps Order 6100.13 - Marine Corps Physical Fitness Program. Washington, DC, Department of the Navy, Headquarters United States Marine Corps.
5. Tiesman HM, Peek-Asa CL, Zwerling CS, Sprince NL, Amoroso PJ: Occupational and non-occupational injuries in the United States Army: focus on gender. Am J Prev Med 2007; 33(6): 464–70.
6. Lauder TD: Sports and physical training injury hospitalizations in the Army. Am Prev Med 2000; 18(3 Suppl): 118–28.
7. Dunken MA: Handout on Health: Sports Injuries. National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS) 2009; NIH Publication No. 09–5278.
8. Neely FG: Intrinsic risk factors for exercise-related lower limb injuries. Sports Med 1998; 26(4): 253–63.
9. Rosendal L, Langberg H, Skov-Jensen A, Kjaer M: Incidence of injury and physical performance adaptations during military training.Clin J Sport Med 2003; 13(3):157–63.

10. Linenger JM, West LA: Epidemiology of soft-tissue/musculoskeletal/injury among U.S. Marine recruits undergoing basic training. Mil Med 1992; 157(9): 491–3.
11. Bell NS, Mangione TW, Hemenway D, Amoroso J, Jones BH: High injury rates among female Army trainees: a function of gender? Am J Prev Med 2000; 18(3 Suppl): 141–6.
12. Sharp MA, Knapik JJ, Walker LA, Burrell L, Frykman PN, Darakjy SS,Lester ME, Marin RE: Physical fitness and body composition after a 9-month deployment to Afghanistan. Med Sci Sports Exerc 2008; 40(9):1687–92.
13. Krentz MJ, Li G, Baker SP: At work and play in a hazardous environment: injuries aboard a deployed U.S. Navy aircraft carrier. Aviat Space Environ Med 1997; 68(1): 51–5.
14. Brodine SK, Shaffer RA, Weech Johnson C, Le AT, Garland C: Get SMARTS! (Sports Medicine Research Team System): A Computerized Outpatient Data Collection System for Epidemiological Research. Technical Report 95-29 Washington, DC, Department of the Navy, 1995.
15. Baker SP, O'Neill B, Haddon W Jr, Long WB: The Injury Severity Score: a method for describing patients with multiple injuries and evaluating emergency care. J Trauma 1974; 14(3): 187–96.
16. Galarneau M, Hancock WC, Konoske P, Melcer T, Vickers R, Walker G, Zouris J: The Navy-Marine Corps Combat Trauma Registry. Mil Med 2006; 171(8): 691–7.
17. Darakjy S, Marin RE, Knapik JJ, Jones BH: Injuries and illnesses among armor brigade soldiers during operational training. Mil Med 2006; 171(11): 1051–6.
18. Lincoln AE, Smith GS, Amoroso PJ, Bell NS: The natural history and risk factors of musculoskeletal conditions resulting in disability among US Army personnel. Work 2002; 18(2): 99–113.

19. Meeuwisse WH, Tyreman H, Hagel B, Emery C: A dynamic model of etiology in sport injury: the recursive nature of risk and causation. Clin J Sport Med 2007; 17(3): 215–9.
20. Gissane C, White J, Kerr K, Jennings D: An operational model to investigate contact sports injuries. Med Sci Sports Exerc 2001; 33(12): 1999–2003.
21. Bahr R, Holme I: Risk factors for sports injuries-a methodological approach. Br J Sports Med 2003; 37(5): 384–92.
22. Jones BH, Cowan DN, Knapik JJ: Exercise, training and injuries. Sports Med 1994; 18(3): 202–14.

TABLE I. Descriptive Statistics of Marines Injured During Sports or Recreational Activities While Deployed in Iraq: 2004–2006

Variable Type	Variable	Strata	Frequency (*n*)	%
Demographic				
	Education level	High school or less	485	87.7
		College or more	70	12.6
	Sex	Male	531	95.7
		Female	24	4.3
	Age, years	17–20	69	12.4
		21–25	294	53.0
		26–32	117	21.1
		33+	75	13.5
Military				
	MOS	Combat	191	34.4
		Intelligence&log	78	14.1
		Support	286	51.5
	Deployments	1	383	69.0
		2	142	25.6
		3	30	5.4
	Months deployed	0–2	175	31.5
		3–5	251	45.2
		6+	129	23.2
	Paygrade	E1–E3	184	33.2
		E4–E6	279	50.3
		E7–E9	41	7.3
		Officer	51	9.2
Sport and injury				
	Sport	Weight lifting	143	25.8
		Aerobics	113	20.4
		Other/unknown	96	17.3
		Basketball	85	15.3
		Football	60	10.8
		Wrestling/boxing	34	6.1
		Volleyball	24	4.3
	Injury mechanism	Lifting	127	22.9
		Fall/trip	115	20.7
		Twist/pull	105	18.9
		Other/unknown	97	17.5
		Struck another	63	11.4
		Struck object	48	8.6

	Injury type	Strain/sprain	350	63.1
		Superficial	93	16.8
		Other/unknown	43	7.7
		Fracture	40	7.2
		Dislocation/sublux	29	5.2
	Anatomical location	Lower extremity	218	39.3
		Upper extremity	177	31.9
		Pelvis/abd/thorax	102	18.4
		Head/face/neck	58	10.5
	Injury Severity Score	1	483	87.8
		2	18	3.3
		>2	49	8.9
Lost-duty injury				
		Yes	258	46.5
		No	297	53.3
Totals			555	100.0

Intelligence&log: intelligence and logistics specialties; MOS: Military Occupational Specialty; Dislocation/sublux: dislocation/subluxation; Pelvis/abd/thorax: pelvis/abdomen/thorax.

TABLE II. Sport Played When Injured by Demographic and Military Factors in Iraq-Deployed U.S. Marines, 2004–2006

	Education		Age (years)				Military Specialty		
Sport	High School or Less	College or Higher	18–20	21–25	26–32	33+	Combat	Intell& log	Support
Aerobics	19.2[b]	28.6[a]	15.9	21.2	17.9	25.3	18.3	14.1	23.4
Basketball	16.1	10.0	17.4	17.0	12.8	10.7	14.1	15.4	16.1
Football	11.5	5.7	14.5	13.3[a]	8.5	1.3[b]	12.6	6.4	10.8
Other/unk	17.5	15.7	20.3	15.0	15.4	26.7[a]	17.3	23.1	15.7
Volleyball	4.5	2.9	4.3	3.4	6.0	5.3	4.2	2.6	4.9
Weights	24.1[b]	37.1[a]	20.3	15.0	15.4	26.7[a]	23.0	37.2[a]	24.5
Boxing/wr	7.0[a]	0.0[b]	7.2	7.8[a]	4.3	1.3[b]	10.5[a]	1.3[b]	4.5
Total %	100	100	100	100	100	100	100	100	100
Total (*n*)	485	70	69	294	117	75	191	78	286
	$\chi^2 = 15.5$, $p = .017$		$\chi^2 = 31.7$, $p = .024$				$\chi^2 = 22.8$, $p = .029$		

	Rank				Deployments[*]			Deployment length[†]		
Sport	E1–E3	E4–E6	E7–E9	Officer	1	2	3+	0–2	3–5	6+
Aerobics	22.3	16.1[b]	26.8	31.4[a]	21.1	17.6	23.3	24.0	19.1	17.8
Basketball	18.5	15.4	4.9[b]	11.8	13.3[b]	19.0	23.3	18.3	13.5	14.7
Football	11.4	12.5	2.4[b]	5.9	11.8	9.2	6.7	8.6	12.0	11.6
Other/unk	17.4	16.8	22.0	15.7	15.4[b]	22.5[a]	16.7	18.3	17.9	14.7
Volleyball	3.3	4.7	7.3	3.9	4.7	3.5	3.3	1.7[b]	5.6	5.4
Weights	20.1[b]	27.2	36.6	29.4	27.2	22.5	23.3	22.3	25.5	31.0
Boxing/wr	7.1	7.2	0.0[b]	2.0	6.5	5.6	3.3	6.9	6.4	4.7
Total %	100	100	100	100	100	100	100	100	100	100
Total (*n*)	184	279	41	51	383	142	30	175	251	129
	$\chi^2 = 27.6$, $p = .074$				$\chi^2 = 10.4$, $p = .583$			χ^2=12.0, p=.446		

[a]Adjusted residual for this cell ≥ +1.7, indicating more cases than expected.
[b]Adjusted residual for this cell ≤ -1.7, indicating fewer cases than expected.
[*]Total number of previous and current deployments.
[†]Length in months of current deployment up until sports injury.
Box/wr: boxing or wrestling; Intell&Log: intelligence and logistics specialties; Weights: weight lifting.

Table III. Sport Played by Injury Mechanism, Anatomical Location, and Injury Severity Score in Iraq-Deployed Marines, 2004–2006

	Sport						
Injury mechanism	Aerobics	Basketball	Football	Other/unk	Volleyball	Weight lifting	Wrestling/box
Fall/trip	34.5[a]	43.5[a]	23.3	18.8	20.8	0.7[b]	2.9[b]
Twist/pull	35.4[a]	14.1	11.7	31.2[a]	12.5	7.0[b]	8.8
Lifting	0.9[b]	0.0[b]	0.0[b]	1.0[b]	0.0[b]	85.3[a]	8.8[b]
Other/unk	19.5	27.1[a]	28.3[a]	20.8	33.3[a]	2.1[b]	11.8
Struck another	0.9[b]	14.1	23.3[a]	13.5	25.0[a]	0[b]	50.0[a]
Struck object	8.8	1.2[b]	13.3	14.6[a]	8.3	4.9[b]	17.6[a]
Total %	100	100	100	100	100	100	100
Total (*n*)	113	85	60	96	24	143	34
	χ^2=567, p <.001						
Anatomical location	Aerobics	Basketball	Football	Other/unk	Volleyball	Weight lifting	Wrestling/box
Head/neck/face	2.7[b]	9.4	6.7	16.7[a]	12.5	9.8	29.4[a]
Lower extremity	74.3[a]	64.7[a]	36.7	37.5	50.0	4.9[b]	5.9[b]
Pelvis/abd/thorax	14.2	5.9[b]	5.0[b]	15.6	12.5	37.1[a]	20.6
Upper extremity	8.8[b]	20.0[b]	51.7[a]	30.2	25.5	48.3[a]	44.1
Total %	100	100	100	100	100	100	100
Total (*n*)	113	85	60	96	24	143	34
	χ^2 = 212, p < .001						
Injury Severity Score	Aerobics	Basketball	Football	Other/unk	Volleyball	Weight lifting	Wrestling/box
1	92.0	85.7	80.0[b]	89.5	77.3	91.5	79.4
2	1.8	4.8	3.3	5.3	0.0	3.5	0.0
>2	6.2	9.5	16.7[a]	5.3	22.7[a]	4.9[b]	20.6[a]
Total %	100	100	100	100	100	100	100
Total (*n*)	113	84	60	95	22	142	34
	χ^2 = 24.74, p = .016						

[a]Adjusted residual for this cell ≥ +1.7, indicating more cases than expected.
[b]Adjusted residual for this cell ≤ -1.7, indicating fewer cases than expected.
Note: The chi-square analysis comparing sports by injury type was not done because of very low counts in several cells.
Intell&Log: intelligence and logistics specialties; ISS: Injury Severity Score.

TABLE IV. Lost-Duty Time by Sport, Military, and Demographic Factors in Iraq-Deployed U.S. Marines, 2004–2006

	Education		Age (years)				Military Specialty		
Lost duty	High School or Less	College or Higher	18–20	21–25	26–32	33+	Combat	Intell& Log	Support
No	51.1[b]	70.0[a]	49.3	48.3[b]	58.1	70.7[a]	48.7	73.1[a]	51.4
Yes	48.9[a]	30.0[b]	50.7	51.7[a]	41.9	29.3[b]	51.3	26.9[b]	48.6
Total %	100	100	100	100	100	100	100	100	100
Total (*n*)	485	70	69	294	117	75	191	78	286
	χ^2 = 8.75, *p* = .003		χ^2 = 13.58, *p* = .004				χ^2=14.3, *p* = .001		

	Rank				Deployments*			Deployment Length†		
Lost duty	E1–E3	E4–E6	E7–E9	Officer	1	2	3	0–2	3–5	6+
No	40.2[b]	56.3	70.7[a]	72.5[a]	53.0	57.3[a]	46.2	52.0	52.2	58.1
Yes	59.8[a]	43.7	29.3[b]	27.5[b]	47.0	42.7[b]	53.8	48.0	47.8	41.9
Total %	100	100	100	100	100	100	100	100	100	100
Total (*n*)	184	279	41	51	251	211	93	175	251	129
	χ^2=26.25, *p* = <.001				χ^2=4.76, *p* = .093			χ^2=1.45, *p* =.485		

	Sport						
Lost duty	Aerobics	Basketball	Football	Other/unknown	Volleyball	Weights	Boxing/Wrestling
No	53.1	34.1[b]	46.7	60.4	41.7	64.3	58.8
Yes	46.9	65.9[a]	53.3	39.6	58.3	35.7[b]	41.2
Total %	100	100	100	100	100	100	100
Total (*n*)	113	85	60	96	24	143	34
	χ^2=24.30, *p*=<.001						

	Anatomical Location				Injury Type				
Lost duty	Head/face/neck	Lower Extremity	Pelvis/abd/thor	Upper Extremity	Dislocation/sub	Fracture	Other/unk	Sprain/strain	Superficial
No	60.3	45.0[b]	55.9	60.5[a]	31.0[b]	32.5[b]	58.1	55.4	60.2
Yes	39.7	55.0[a]	44.1	39.5[b]	69.0[a]	67.5[a]	41.9	44.6	39.8
Total %	100	100	100	100	100	100	100	100	100
Total (*n*)	58	218	102	177	29	40	43	350	93
	χ^2= 11.16, p=.011				χ^2=15.56, *p* = <.004				

	Injury Mechanism						Injury Severity		
Lost duty	Fall/trip	Twist/pull	Lifting	Other/unk	Struck Another	Struck Object	1	2	3
No	40.0[b]	56.2	65.4[a]	55.7	47.6	52.1	56.7[a]	50.0[b]	20.4[b]
Yes	60.0[a]	43.8	34.6[b]	44.3	52.4	47.9	43.3	50.0	79.6[a]
Total %	100	100	100	100	100	100	100	100	100
Total (*n*)	115	105	127	97	63	48	483	18	49
	χ^2=17.00, p = <.004						χ^2=23.65, p<.001		

[a] Adjusted residual for this cell ≥ +1.7, indicating more cases than expected.
[b]Adjusted residual for this cell ≤ -1.7, indicating fewer cases than expected.
[*]Total number of previous and current deployments.
[†]Length in months of current deployment up until sports injury.
Dislocation/sub: dislocation and/or subluxation; Intell&log: intelligence and logistics specialties..

TABLE V. Multivariate Logistic Regression Predicting Lost-Duty Time from Demographic, Military, and Sports Injury Variables[a]

Variable	B	Odds Ratio (CI $_{95\%}$)	Significance
Education group	--	--	[b]
Age group	--	--	[b]
Rank			<.01
E1–E3	1.49	4.43 (2.07, 9.51)	<.01
E4–E6	.76	2.14 (1.03, 4.47)	.04
E7–E9	.21	1.23 (0.46, 3.34)	.68
Officer	(ref)	--	--
Military Specialty			<.01
Combat	1.02	2.78 (1.47, 5.27)	<.01
Support	.82	2.28 (1.23, 4.20)	<.01
Intell&log	(ref)	--	--
Sport			.05
Basketball	.91	2.48 (1.31, 4.68)	<.01
Football	.21	1.31 (0.65, 2.66)	.45
Other/unknown	-.02	0.90 (0.53, 1.82)	.95
Volleyball	.49	1.63 (0.58, 4.55)	.35
Weight lifting	-.02	0.98 (0.52, 1.83)	.94
Boxing/wrestling	-.32	0.73 (0.29, 1.79)	.49
Aerobics	(ref)	--	--
Injury mechanism	--	--	[b]
Injury type	--	--	[b]
Anatomical location			.02
Lower extremity	.81	2.24 (1.10, 4.56)	.03
Upper extremity	.18	1.20 (0.60, 2.40)	.61
Pelvis/abd/thorax	.74	2.10 (1.01, 4.42)	.05
Head/neck/face	(ref)	--	--
Injury Severity Score			<.01
>2	1.86	6.43 (2.92, 14.15)	<.01
2	.60	1.82 (0.67, 4.94)	.24
1	(ref)	--	--

[a]Using backward elimination procedures, variables that were significant at the bivariate level (see Table IV) were all initially entered into this model, then eliminated one at a time until only significant ($p \leq .05$) independent predictors remained in the model.
[b]Not significant in multivariate model.
Pelvis/abd/thorax: pelvis/abdomen/thorax; Intell&Log: intelligence & logistics; (ref) indicates that the category was used as the reference group.

REPORT DOCUMENTATION PAGE

1. REPORT DATE (DD MM YY)
07 06 11

2. REPORT TYPE
Technical Report

3. DATES COVERED (from – to)
February 2009–February 2010

4. TITLE
Sports and Recreational Injuries in Relation to Lost Duty Time Among Deployed U.S. Marine Corps Personnel

5a. Contract Number:
5b. Grant Number:
5c. Program Element Number:
5d. Project Number:
5e. Task Number:
5f. Work Unit Number: 60332

6. AUTHORS
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8. PERFORMING ORGANIZATION REPORT NUMBER
Report No. 11-47

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10. SPONSOR/MONITOR'S ACRONYM(S)
NMRC/BUMED

11. SPONSOR/MONITOR'S REPORT NUMBER(s)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES until publication.

14. ABSTRACT

This study examined leisure-time sports injuries and lost duty time among U.S. Marines deployed in Iraq. All sports and recreational injuries in Iraq during 2004–2006 were identified from the Combat Trauma Database, in which all in-theater medical treatment was recorded. The study population consisted of 555 Marines who sought treatment for a sports injury during this period. The majority of cases were men aged 21–25 years with a high school education and mid-range enlisted rank. Demographic and military descriptors were related to the type of sports activity engaged in when injured, but had little association with injury characteristics. Type of sports activity, however, was associated with anatomical site of injury, injury mechanism, type of injury, and injury severity. Over 60% of sports injuries occurred during weightlifting, aerobics, and basketball. Some loss of duty time occurred in 46.5% of all sports injuries. Multivariate analyses indicated that rank, occupational specialty, sport played when injured, anatomical location of injury, and injury severity were significant independent predictors of lost duty time. These findings describing leisure-time sports injuries among deployed Marines may help identify at-risk subgroups, and suggest preventive interventions to reduce sports-related injuries and lost duty time in combat theaters.

15. SUBJECT TERMS
military personnel, Iraqi combat theater, leisure time injury

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	18a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Commanding Officer
UNCL	UNCL	UNCL	UNCL	23	18b. TELEPHONE NUMBER (INCLUDING AREA CODE) COMM/DSN: (619) 553-8429